

### **REMARKS**

The Final Office Action mailed December 28, 1999, has been received and reviewed. Claims 1 through 47 are currently pending in the application. Claims 1 through 47 stand rejected. Applicant proposes to amend claim 33, and respectfully requests reconsideration of the application as proposed to be amended herein.

#### **35 U.S.C. § 112 Claim Rejections - Claims 1-47**

Claims 1 through 47 stand rejected under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Applicant respectfully traverses this rejection, as hereinafter set forth.

Responding to the same rejection in the Official Action of March 26, 1999, and the Supplemental Office Action of April 7, 1999, the Applicant clearly pointed out that the Specification at least defines one formation of  $WSi_x$  as  $WSi_2$ . *See, Amendment*, July 7, 1999. The Examiner does not comment on this clarification although it overcomes the current rejection. The Specification specifically states: "Tungsten silicide, generally in the form of  $(WSi_2)$ , can be used in the formation of integrated circuits as an intermediate, barrier, or conducting film." *Specification*, col. 1, lines 15-18. This disclosure enables one having ordinary skill in the art to make and use tungsten silicide having the formula  $WSi_2$  with the present invention without any undue experimentation. Thus, the 35 U.S.C. § 112 rejection of claims 1-47 should be withdrawn because  $WSi_x$  is at least defined as  $WSi_2$ .

In addition, Applicant maintains that the disclosure of the general formula for tungsten silicide,  $WSi_x$ , is sufficient to enable one skilled in the art to make the present invention despite the Examiner's contention that "without defining or specifying numerical values of x, one cannot determine the final product so that the invention can be practiced." *See, Final Action*, page 2, section 1. Claims 1-47 have been rejected under 35 U.S.C. § 112, first paragraph, because "in order to form a  $WSi_x$  which encompasses all form of tungsten silicide, one having ordinary skill in

the art would necessarily perform tremendous undue experimentation.” See, *Final Action*, page 9, section 5(a). The Applicant disagrees with this statement.

Responding to the Applicant’s arguments from the Official Action of March 26, 1999, and the Supplemental Office Action of April 7, 1999, the Examiner indicates that “the desired stoichiometry of a tungsten silicide film having a general formula  $WSi_x$  is known to depend largely on the deposition conditions such as active gases flow rates, deposition temperature, etc.” See, *Final Action*, page 8, section 5(a). The Specification provides these necessary details. For example, the Specification lists both the reactive gases and carrier gases which may be used in the deposition of a  $WSi_x$  film. See, *Specification*, col. 3, lines 21-39. The Specification also details the desired flow rates of the gases:

The flow rate of the carrier gases (Ar,  $N_2$ , He) may be as great as five to ten times the flow rate of the silicon source gas (either silane or dichlorosilane). The flow rate of the silicon source gas (either silane or dichlorosilane) in turn may be about 50-100 times the flow rate of the reactant gas. *Specification*, col. 3, lines 39-44.

Furthermore, the Specification provides an example of a deposition of  $WSi_x$  which includes the necessary gases, temperatures, and flow rates to produce one form of the present invention. See, *Specification*, col. 3, line 62 to col. 4, line 9. Hence, the Specification provides those details which the Examiner contends are necessary to prevent “undue experimentation.”

The Specification also exceeds the requirements of 35 U.S.C. § 112, first paragraph, when considered in light of the “undue experimentation” factors described by the Board of Patent Appeals and the Federal Circuit:

Factors to be considered in determining whether a disclosure would require undue experimentation have been summarized by the board in *Ex parte Forman*. They include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence of absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

*In re Wands*, 8 U.S.P.Q.2d 1400, 1404 (Fed. Cir. 1988)(citing, *Ex parte Forman*, 230 U.S.P.Q. at 547). The quantity of experimentation necessary to carry out the present invention is minuscule, if any is at all necessary, because of the guidance and working examples provided in the specification. See, *supra*. In addition, the use, formation, and qualities of tungsten silicide ( $WSi_x$ ) are commonly known in the art as is acknowledged by the Examiner’s citation to the two

United States Patents (Brors, U.S. Pat. 4,851,295 and Ohba, U.S. Pat. 4,902,645) which detail different forms of  $\text{WSi}_x$ . The formation of various stoichiometric mixtures of  $\text{WSi}_x$  are well known. Analysis of the "undue experimentation" factors in light of the Specification and the knowledge generally known and available in the prior art precludes the 35 U.S.C. § 112, first paragraph, rejection of claims 1-47.

Claims 1-47 have also been rejected under 35 U.S.C. § 112, first paragraph because the allowance of all forms of tungsten silicide in the present application "would prevent others from obtaining a new and useful composition of tungsten silicide." *See, Final Action*, page 9, section 5(b). However, the Applicant does not claim all forms of tungsten silicide. Instead, the claims recite a semiconductor manufacturing process in which many forms of tungsten silicide may be used. Thus, a new and useful composition of tungsten silicide would not be prevented by the present application because the application involves a process of manufacturing.

For the foregoing reasons, the 35 U.S.C. § 112, first paragraph rejection of claims 1-47 should be withdrawn and the claims allowed for issue.

### **35 U.S.C. § 112 Claim Rejections - Claims 33-38**

Claims 33 through 38 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. More specifically, claims 33 through 38 stand rejected because the limitation "the discontinuous nucleation layer" recited at the 4<sup>th</sup> line of claim 33 lacks antecedent bases.

Applicant has amended the application in accordance with the teachings of the Specification to overcome this rejection. *See, Specification*, col. 3, lines 57-62. Applicant respectfully requests the entry of the amendment and allowance of claims 33-38.

### 35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on Japanese Patent No. 39528 to Kawanishi et al. Taken With U.S. Patent No. 4,632,057 to Price et al.

Claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawanishi et al. (Japanese Patent No. 39528) taken with Price et al. (U.S. Patent No. 4,632,057). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

The 35 U.S.C. § 103(a) obviousness rejections of claims 1, 2, 4, 5, 8, 9, 12 through 19, and 21 are improper because a *prima facie* case of obviousness has not been established. Kawanishi and Price et al., individually or collectively, fail to motivate the present invention. In fact, both Kawanishi and Price et al. teach away from the present invention.

Kawanishi does not motivate a combination with Price et al., and Price et al. does not motivate a combination with Kawanishi, therefore a *prima facie* case of obviousness can not be established. The Examiner indicates that "applying Price's teaching to the process of Kawanishi with motivation as recited in the rejection which [sic] results in a combined process which does not include the plasma ignition step." See, *Official Action*, page 9-10. The recited motivation in the rejection is two-fold: First, the Examiner indicates that it would be "obvious to deposit the WSi<sub>2</sub> film of Kawanishi at the temperature range suggested by Price because lower temperature deposition would be beneficial in that thermal budget is reduced while assuring substantially the same deposition characteristics...as the film is deposited at 680°C." See, *Official Action*, page 5. Second, the Examiner indicates that Price et al. teaches that once a nucleation layer is formed,

deposition at temperatures in the range of 390-400°C will occur. *See, Id.* Both of these “motivations” offered by the Examiner apparently fail to consider the express teachings of the art from which they apparently originate.

Kawanishi expressly teaches that low treatment temperature formation of metal silicides is undesirable because “the  $\text{WSi}_2$  film formed by such a low-temperature treatment had a poor adhesion with the substrate and a poor step coverage. Furthermore, the film formation time was lengthened greatly, and the productivity was decreased.” *See, Kawanishi*, English translation, page 4, ¶ 4. This teaching fails to support the first motivation offered by the Examiner. In fact, the statement teaches just the opposite: low-temperature deposition is not beneficial. Therefore, Kawanishi teaches away from the present invention and away from any combination with Price et al.

Price et al. teaches that the formation of a nucleation layer of tungsten disilicide during a low-temperature, one-step deposition process requires plasma discharge to initiate/nucleate the tungsten disilicide layer. *See, Price et al.*, col. 5, lines 60-63. Contrary to the second contention of the Examiner, Price et al. does not teach “that once a nucleation layer of tungsten disilicide [is] formed...a  $\text{WSi}_2$  film can be deposited in a range of 390-400°C” in a second deposition step. *See, Official Action*, page 5. Thus, Price et al. fails to motivate depositions in the range of 390-400°C following a first nucleation deposition step.

The only motivation to be found for the deposition of tungsten silicide films at low temperatures is in the present invention. Kawanishi does not motivate a combination with Price et al. because Kawanishi expressly teaches that a second low-temperature deposition is undesirable. Furthermore, the teaching of the one-step deposition process which requires plasma deposition in Price et al. would not lead one of ordinary skill in the art to combine the low-temperature deposition of Price et al. with any other art in the absence of the required plasma deposition. The only document which teaches that deposition of tungsten silicide is desirable at low-temperatures is the present specification. To make obvious the present invention, a combination of Kawanishi and Price et al. necessarily requires the teachings and motivation of the present invention. As such, the rejection is an impermissible use of hindsight. The lack of motivation or suggestion to combine Kawanishi with Price et al. in the prior art, and the express teachings of the references

away from one another, and away from the present invention, precludes an obviousness rejection because the first requirement of a *prima facie* case of obviousness has not been met.

Furthermore, Kawanishi and Price et al. do not teach all of the limitations of the claims, and therefore fail to meet the third requirement for a *prima facie* case of obviousness. Specifically, Kawanishi fails to teach a two-step deposition of tungsten silicide performed at a temperature of less than about 500°C as in claims 1, 2, 5, 8, 9, and 13-17. Likewise, Kawanishi fails to teach a two-step deposition of tungsten silicide performed at a temperature of less than about 400°C as in claims 4 and 21. Furthermore, Kawanishi fails to teach a two-step deposition process wherein both steps are effected at a substantially equivalent temperature as recited in claims 16-19 and 21. The failure of Kawanishi to teach the deposition temperature limitations of the present invention precludes a *prima facie* case of obviousness.

Price et al. also fails to teach all of the limitations of the claims of the present invention. Price et al. specifically describe a single step deposition at a temperature around 400°C wherein the deposition itself is initiated by plasma discharge. The Price et al. deposition is also carried out using a single silicon source gas, rather than two separate silicon source gases as in the two-step process of the present invention. The lack of a teaching of a two-step deposition process, and the failure of Price et al. to teach deposition at a temperature in the range of 390-400°C using two separate silicon source gases precludes a *prima facie* case of obviousness based on Price et al.

Claims 1, 8, and 18 are not obvious in light of Kawanishi or Price et al. individually, or in combination. Likewise, claims 2, 4, 5, 9, 12-17, 19, and 21 are not made obvious by Kawanishi or Price et al. Furthermore, claims 2, 4, 5, 9, 12-17, 19, and 21 are not obvious because they depend from claims 1, 8, and 18 which are nonobvious. Applicant respectfully requests that the 35 U.S.C. § 103(a) rejection of claims 1, 2, 4, 5, 8, 9, 12-19, and 21 be removed and a notice of allowance issued.

Obviousness Rejection Based on Japanese Patent No. 39528 to Kawanishi et al. Taken With U.S. Patent No. 4,632,057 to Price et al., and Further in View of U.S. Patent No. 4,565,157 to Brors et al.

Claims 3, 6, 7, 10, 11, 20, 22, and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawanishi et al. (Japanese Patent No. 39528) taken with Price et al. (U.S. Patent No. 4,632,057), and further in view of Brors et al. (U.S. Patent No. 4,565,157). Applicant respectfully traverses this rejection, as hereinafter set forth.

Claims 3, 6, 7, 10, 11, 20, 22, and 23 each depend from independent claims 1, 8, or 18. As dependent claims, claims 3, 6, 11, 20, 22, and 23 are not obvious if the independent claims from which they depend are nonobvious. *See, In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988); *see also*, MPEP § 2143.03. As explained *supra*, independent claims 1, 8, and 18 are nonobvious, therefore claims 3, 6, 7, 10, 11, 20, 22, and 23 are nonobvious.

Furthermore, the combination of Brors with Kawanishi and Price fails to establish a prima facie case of obviousness of claims 3, 6, 7, 10, 11, 20, 22, and 23. There is no motivation to combine the cold wall CVD reactor of Brors with Kawanishi or Price to achieve deposition of tungsten silicide as taught in the present invention. Likewise, the combined teachings of Brors, Kawanishi and Price would necessitate a plasma ignition step to achieve the deposition of tungsten silicide, which is not present in the current invention. The lack of motivation to combine Brors with Kawanishi and Price, and the expectation of failure without a plasma ignition step as in Price, precludes a prima facie case of obviousness. Therefore, claims 3, 6, 7, 10, 11, 20, 22, and 23 are nonobvious and allowable over the combination of Brors with Kawanishi and Price.

#### **ENTRY OF AMENDMENTS**

The proposed amendments to claim 33 above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application. Further, the amendments do not raise new issues or require a further search. Finally, if the Examiner determines that the amendments do not place the application in condition for allowance, entry is respectfully requested upon filing of a Notice of Appeal herein.

## CONCLUSION

Claims 1-47 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicant's undersigned attorney.

Respectfully Submitted,



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